

THE EXTERNAL MORPHOLOGY OF HYDROUS TRIANGULARIS (HYDROPHILIDAE: COLEOPTERA)

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INTRODUCTION

The water-scavenger beetles live upon decomposing vegetable matter. They are found in the shallow water of quiet lakes and ponds, among the plants growing on the bottom. This study was made principally at the Franz Theodore Stone Laboratory of Ohio State University at Gibraltar Island, Put-in-Bay, Ohio. The greater part of the work was done with preserved material. One specimen was taken in a quiet pool on the shore of North Bass Island.

Hydrous triangularis is one of the larger species, having a length of 35 to 39 mm. and a maximum width of 14 to 17 mm. This genus is found in all parts of the United States and contains some of the largest and smallest members of the family.

The nomenclature used by the writer is adapted from the literature of such entomologists as Snodgrass, Korschelt, Imms and others.

This study was suggested by and made under the direction of Dr. C. H. Kennedy, of the Ohio State University, to whom the writer wishes to express sincere thanks for his many helpful criticisms and suggestions.

THE HEAD

(Pl. I, Figs. 1 to 11)

The head capsule is rounded and about as long from the occipital foramen to the anterior margin of the labrum as it is wide between the eyes. The frontal sutures extend diagonally from the anterior margin of the eyes to the coronal suture which divides the vertex longitudinally. The head is normally partly withdrawn into the prothorax. The dorsal part of the vertex and clypeus are coarsely punctate. (Pl. I, Fig. 1).

The mouth-parts are in front of the head and the head is dorso-ventrally flattened. The ventral wall of the hind part of the head is formed by the gula, which extends from the occipital region to the submentum. The gula is elongate and is bounded laterally by the

gular sutures. The surface of the gula is separated from that of the submentum by a dividing suture. (Pl. I, Fig. 10.) A definite mentum is present. (Pl. I, Fig. 3.) In the grasshopper and other more primitive insects, the head is antero-posteriorly compressed and the mouth-parts are beneath the head. In the grasshopper a sclerite corresponding to the gula is not present, because of the short distance between the base of the submentum and the cervix.

The mandibles have five teeth and a retinaculum is prominent as a soft semicircular shelf between the premolar and molar regions. (Pl. I, Fig. 7.) The galea, digitus and lacinia of the maxillae are profusely marginate with long hairs. A prominent palpifer and subgalea are present and from the former arises the six-jointed palpus. A basal piece or cardo is present. (Pl. I, Fig. 4.) The labium bears two four-jointed palps, between which are the paraglossae. (Pl. I, Fig. 10).

The lamellate antennae are nine-jointed and are attached to the ventral side of the head between the eyes and the bases of the mandibles. (Pl. I, Fig. 11.) Attached to each lateral margin of the head is a large compound eye. These constitute a large part of the surface of the head.

The tentorium (Pl. I, Fig. 3) is braced in the occipital region by two posterior tentorial arms. Each dorsal arm of the tentorium arises from the sides of the body of the tentorium, between the anterior and posterior arms. These support the dorsal part of the head in the region of the antennal sclerite. Each anterior tentorial arm opens on the head posterior to the mandible.

THE PROTHORAX

(Pl. I, Fig. 9)

The anterior margin of the prothorax as seen from below is concave and the posterior and lateral margins convex. It is about half as wide along the anterior margin as it is along the posterior margin. The dorsal side is entirely covered by a plate-like pronotum. (Pl. I, Fig. 9.)

On the ventral side are two large propleural plates. (Pl. I, Fig. 9.) Anteriorly these extend from the pronotum to the lateral margin of the precoxal-bridge, (Pl. I, Fig. 9), and posteriorly as a narrow point projecting mediad back of the coxal cavity. The coxal cavities are between the median projections of the propleural plates and the lateral arms of the precoxal-bridge.

The legs of the water-scavenger beetle readily distinguish it from the predacious diving-beetles. Those of the former are equidistant whereas the middle and hind pair of legs are widely separated in the latter. In the male of *Hydrous triangularis*, the fifth joint of the tarsus has a cushion-like enlargement on the inner side called the empodium. The female tarsus consists merely of five normal joints.

THE MESOTHORAX

(Pl. II, Figs. 12, 13, 15, 16)

The meso- and metathorax are very closely connected and give the appearance of a single unit. The mesothorax is the shortest of the three thoracic segments. The largest area of the mesonotum is occupied by a smooth triangular plate, the prescutum. (Pl. II, Fig. 12). The

extreme anterior corners of the prescutum are produced into two hooks or clavicola. From the antero-lateral margins of the prescutum arise the articulations of the elytra. The articular sclerites of the elytra are not shown. The metepisternum and mesopleurum are united dorso-anteriorly by the mesopleural suture. (Pl. II, Fig. 13.)

On the ventral side the largest area of each mesopleurum is occupied by the episternum. This is an elongate sclerite that lies antero-lateral to the basisternum. The episternum and epimerum are divided obliquely by the pleural suture, the lower end of which articulates with the coxa. Meeting the upper end of the pleural suture at right angles is another suture that divides the episternum into supra- and infra-episterna. (Pl. II, Fig. 15.) Extending the length of and beyond the meso- and metathorax is a median spine-like structure, the sternum. This is crossed at the base of the mesothorax by a fine suture. Internally the furca (Pl. II, Fig. 16) arises as two median apodemes. These are connected immediately anterior to the coxae by a furcal ridge. Each branch of the furca is continued at its apical (anterior) end in two free distal arms. One arm extends antero-laterally beneath the episternum, the other as a lateral extension beneath the epimeron.

THE METATHORAX

(Pls. II and III, Figs. 12 to 17)

Posterior to and below the prescutum of the mesothorax is a median groove which lies between the scuto-scutellar sutures. (Pl. II, Fig. 14.) These extend the entire length of the scutum. The scutum is bounded anteriorly by two antero-lateral projections of the scuto-scutellar suture and laterally by the articular processes of the wings. These projections of the scuto-scutellar suture and the articular processes of the wings mark the anterior limit of the metathorax. The articular sclerites of the wings are not shown. Anterior to the metathoracic coxa and on the dorsal surface under the outer edge of the folded wing is a narrow triangular sclerite, the metapleurum. (Pl. II, Fig. 13.) This narrows anteriorly and is connected with the metepisternum by the metapleural suture (Pl. II, Fig. 13), which lies parallel to and just dorsal of the lateral edge of the metathorax. A continuous and definite suture between meso- and metathorax is not present. The prescutum is only loosely connected with the scutum. Medially the connection consists of a transparent membrane, laterally the pleural hooks (Pl. II, Fig. 12) are fused with the lateral margin of the scutum by a membranous structure.

Internally a Y-shaped apodeme, the metathoracic furca (Pl. II, Fig. 16), supports the metathorax. The base of this process arises between the metathoracic coxae. This median apodeme extends dorso-anteriorly toward the metanotum. A short distance below the metatergum arise the two arms.

On the ventral side, the metasternum and episternum are divided by a heavy suture. The episternum is similar to that of the mesothorax except there is no suture dividing it into supra and infra-episterna. The epimeron is not seen from below but is a narrow oblong structure attached to the lateral margin of the episternum and lies

on the dorsal edge of the metathorax. The metathoracic coxa (Pl. II, Fig. 15) has the appearance of another thoracic sclerite. Its ventral surface appears in the form of a flattened elongate plate which extends diagonally from the posterior end of the metapleural suture mediad and caudad to the sternal spine. The coxa is attached along the posterior margin of the metathorax. The attachment is such as to give it a restricted hinge-like movement. Inserted between the posterior edge of the wing of the metasternum and the anterior edge of the coxa is a narrow plate which is probably a much elongate trochantin (Pl. II, Fig. 14) which articulates with the coxa at its inner end. The peculiar structure of the coxa is a distinguishing characteristic of the family.

The wings are membranous and are normally folded beneath the elytra. The venation (Pl. III, Fig. 17) is much reduced. As in the Cantharid (Imms' Ed. 3, Fig. 469, p. 484, 1934) type M_1 and M_2 coalesce distally forming a very definite loop. From the point of junction M_2 is continued to the wing margin. The four anal veins and the first cubitus are distinct. Cubitus two is present but much reduced. The costal and radial veins are clearly seen near the costal margin.

THE ABDOMEN

(Pl. III, Figs. 18 and 19)

There are nine more or less cylindrical segments in the abdomen. The dorso pleural line (Pl. III, Fig. 19) divides the heavily chitinized hypopleurites from the membranous epipleurites. The pleuro ventral line is seemingly an evaginated rounded suture separating the hypopleurites from the sternal plates. Implanted in the membranous epipleurites are eight spiracles (Pl. III, Fig. 18). This number corresponds to the number of epipleurites.

Tergites 1, 2, 3, 4, 5, and 6 are normally covered by the elytra, and appear as tough membranous structures due to a reduction of the chitinization. The seventh and eighth tergites are normally exposed beyond the end of the elytra and are heavily chitinized. The ninth is usually withdrawn under the eighth tergite. The intersegmental membrane of tergites one and two has been obliterated by a definite fusion of these segments. Tergite ten, if present, cannot be differentiated from the ninth.

It is very likely that the first visible sternite contains elements of more than one abdominal segment but they are not indicated by sutures or lines. Five ventral plates or sternites are visible on the abdomen. The first three anterior plates are apparently fused and sternites eight in the female and sternites eight and nine in the male are normally withdrawn within the seventh. The first sternite is produced medially into a short process called the intercoxal process. This extends anteriorly between the metacoxae.

THE MALE GENITAL ORGANS

(Pls. III and IV, Figs. 20, 22, 23, 24)

The ninth sternum is present in the male. A membranous genital chamber arises within the ninth segment. The anus opens beneath the posterior end of the ninth tergite. (Pl. IV, Fig. 23.) The ninth

sternum (Pl. IV, Fig. 23) is extended posteriorly forming a single supporting structure for the genital chamber. Snodgrass (Smith. Misc. Coll., Vol. 85, p. 91, 1931) believes that the movable claspers or parameres (Pl. IV, Fig. 22) are homologous with the styli of the female. Between the two heavily chitinized parameres is a median intromittent organ, or penis. (Pl. IV, Fig. 22.) The penis is a membranous tubular structure bearing the opening of the ejaculatory duct or gonopore at its extremity. The gonopore opens ventrally. A chitinous median plate called the dorsal median strut extends along its dorsal surface. A similar but smaller ventral median strut extends along the ventral surface of the penis. A pair of basal plates underlap the anterior ends of the parameres. The basal plates arise behind the ninth sternite. They are united by the pons basalis into a single V-shaped structure. (Pl. IV, Fig. 24.)

Immediately anterior to the proximal end of the penis is the seminal vesicle. (Pl. III, Fig. 20.) This appears as a ball-like widening of the ejaculatory duct. Anteriorly the seminal vesicle is continued as a narrow tube to which the accessory glands are joined ventrally. In the region of these glands arise the vasa deferentia. Each vas deferens forms the outlet for a testicular tube.

THE FEMALE GENITAL ORGANS

(Pls. III and IV, Figs. 21, 25, 26, 27)

In the female the sternum of the ninth segment appears to be absent. The ninth tergite consists laterally of two narrow lateral projections and medially of a triangular sclerite. (Pl. IV, Fig. 25.) The appendages of the eighth and ninth segments are remotely similar to those of the orthopteran insects. This generalized structure of the genitalia suggests a primitive structure. These genital appendages are absent or rudimentary in many groups of insects, but their wide distribution throughout the orders leaves little doubt of their being primitive structures. The first valvulae are short pointed projections that are supported by two basal plates or valvifers. (Pl. IV, Fig. 27.) Antero-dorsal to the first valvifers are two lobe-like structures, the second valvifers. The second valvulae are absent. The second valvifers are the basal plates of the third pair of valvulae. The third valvulae consist of a long pair of blades each of which is provided with a distal stylus. These appendages of the eighth and ninth segments of the abdomen are potentially gonopods because of the association of the genital openings with these segments. The gonopore opens in the region between the second valvifers. (Pl. IV, Fig. 27.) The anal opening is immediately beneath the ninth tergite. (Pl. IV, Fig. 27.)

Internally a large sac-like structure extends into the eighth segment. (Pl. III, Fig. 21.) This is continued anteriorly as the seminal receptacle, and posteriorly as the bursa copulatrix. Opening into the bursa copulatrix is the vagina which connects with the paired oviducts. Each ovary is composed of three separate egg-tubes or ovarioles.

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EXPLANATION OF PLATES

External anatomy of *Hydrous triangularis* Say

PLATE I

FIG. 1. Head, dorsal view. FIG. 2. Head, ventral view. FIG. 3. Inside view of head showing tentorium from dorsal side. FIG. 4. Dorsal view of left maxilla. FIG. 5. Ventral view of left maxilla. FIG. 6. Ventral view of right mandible. FIG. 7. Lateral view of right mandible. FIG. 8. Dorsal view of right mandible. FIG. 9. Ventral view of prothorax. FIG. 10. Labium, ventral view. FIG. 11. Dorsal view of left antenna.

PLATE II

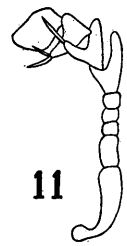
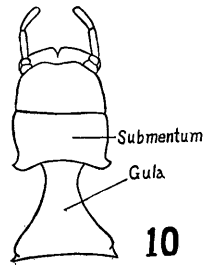
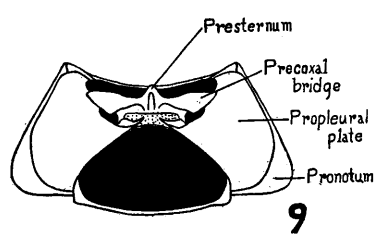
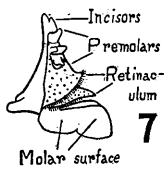
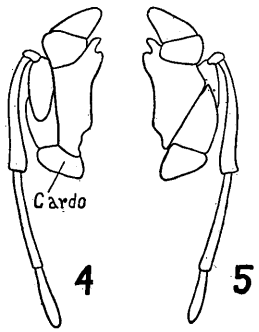
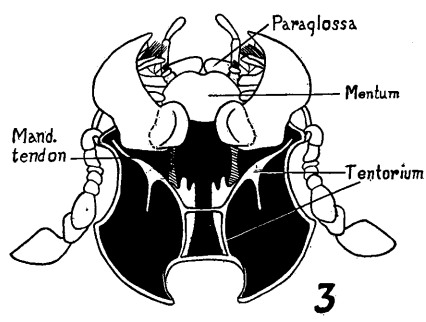
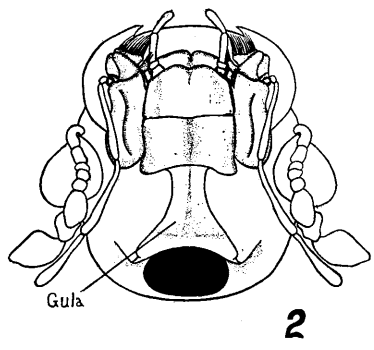
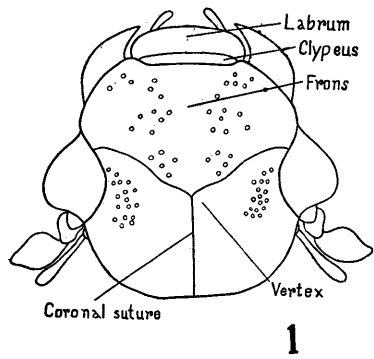
FIG. 12. Mesothorax, dorsal view. FIG. 13. Meso- and metathorax, dorsal view. FIG. 14. Metathorax, dorsal view. FIG. 15. Ventral view of meso- and metathorax. FIG. 16. Internal view of meso- and metathorax, showing furcae, dorsal side removed.

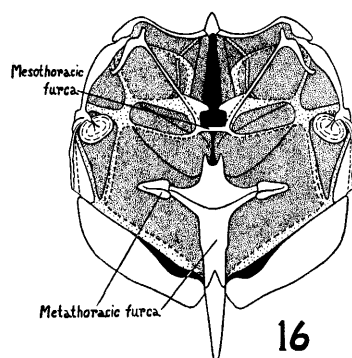
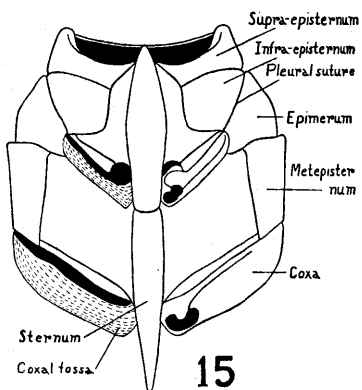
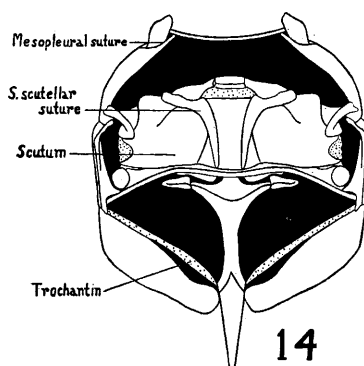
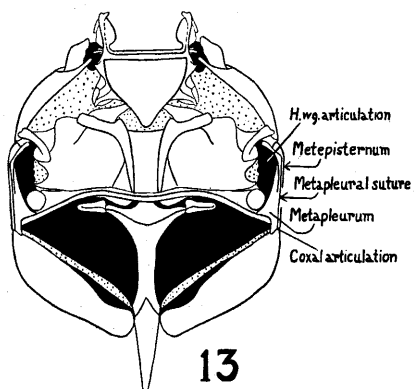
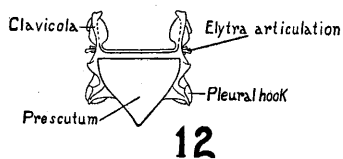
PLATE III

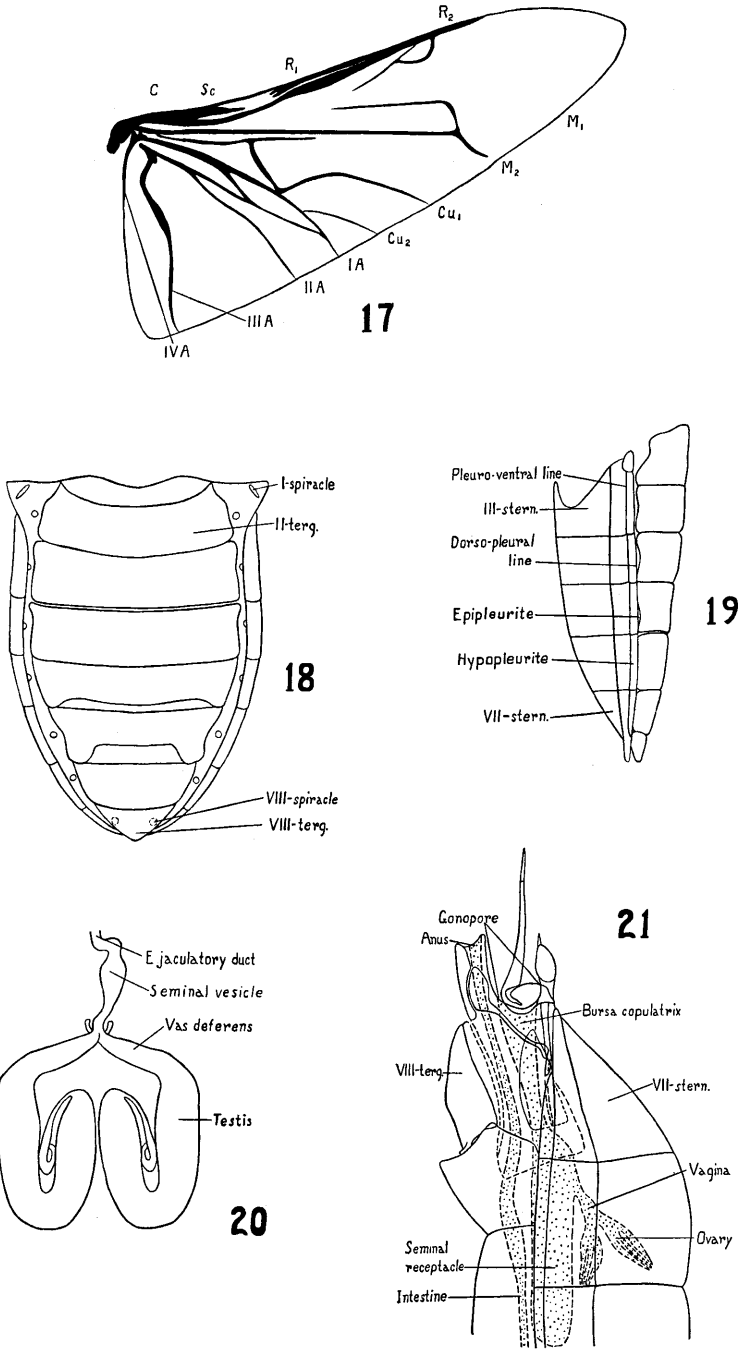
FIG. 17. Left wing, ventral view. FIG. 18. Dorsal view of abdomen. FIG. 19. Lateral view of abdomen. FIG. 20. Male reproductive system. FIG. 21. End segments of abdomen showing female reproductive system.

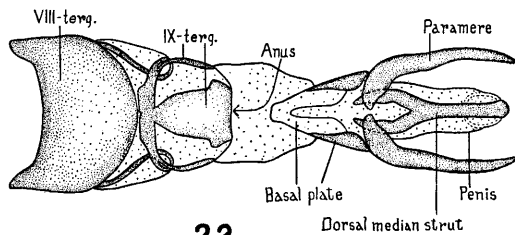
PLATE IV

FIG. 22. Dorsal view of postabdomen of male, abdominal segments 8 and 9. FIG. 23. Lateral view of postabdomen of male, abdominal segments 8 and 9. FIG. 24. Ventral view of postabdomen of male, abdominal segments 8 and 9. FIG. 25. Dorsal view of postabdomen of female, abdominal segments 8 and 9. FIG. 26. Ventral view of postabdomen of female, abdominal segments 8 and 9. FIG. 27. Lateral view of postabdomen of female, abdominal segments 8 and 9.

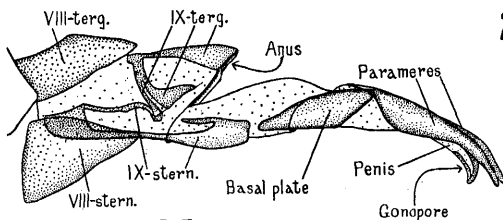




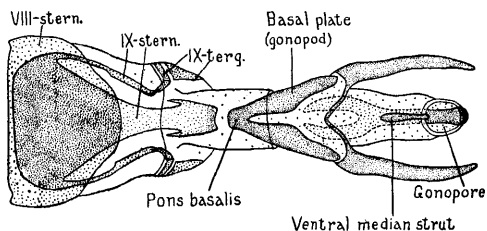




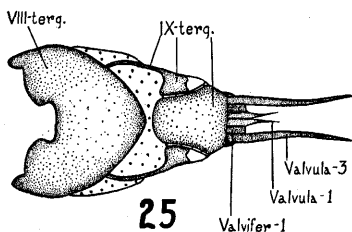
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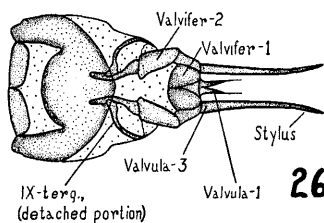
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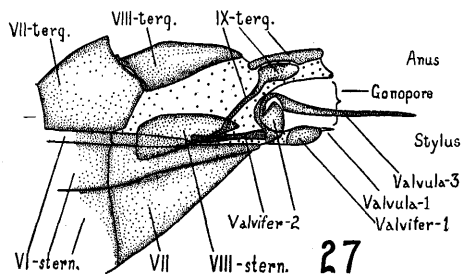
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